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ABSTRACT

This study compares the mathematics achievement and attitude toward mathematics of preservice and experienced elementary school teachers. The research population included teachers from public and private colleges throughout the state of Texas and inservice teachers from suburban communities in the Houston area. Subjects were given an experimenter-designed personal information questionnaire, the Stanford Achievement Test (1974 Advanced Battery, Form X), and the Revised Math Attitude Scale developed by Aiken and Dreger. Findings indicated that prospective and experienced teachers did not differ on overall mathematics achievement, but that experienced teachers performed better on the applications subscale (p less than .01). In addition, experienced teachers had a slightly more positive attitude toward mathematics (p less than .01). Among preservice teachers, mathematics achievement and attitude toward mathematics were higher for those attending private, rather than public, institutions. In both groups, individuals teaching (or planning to teach) grades 4-6 exhibited more favorable attitudes toward mathematics than those preferring to teach K-3. Other findings relate to mathematics background of teachers and size of high school graduating class. The author compares his data with university mathematics requirements, and recommends that the Level recommendations of the Committee on the Undergraduate Program in Mathematics be adopted. (SD)

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PROSPECTIVE AND EXPERIENCED ELEMENTARY TEACHERS: A COMPARISON OF MATHEMATICAL ACHIEVEMENT AND ATTITUDES

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Thousands of prospective elementary teachers are graduated from colleges and universities in the United States each year. While many of these prospective teachers will never enter the teaching profession as regular classroom teachers, the majority will. As a result, hundreds of thousands of children will be affected by their attitudes and teaching competencies. With such large numbers of neophytes entering the teaching profession each year, the responsibility of preparing competent teachers should, if not, be the most challenging task facing modern educators.

Responding to these challenges, many teacher training institutions have implemented innovative programs in order to keep abreast of current trends affecting elementary school programs. One might assume that the end result of such innovative programs would be a more competent teacher; however, a frequent criticism made by many school administrators is that recent teacher graduates do not appear to be adequately prepared for their teaching roles. In an effort to identify certain characteristics and selected competencies of prospective, as well as experienced elementary teachers, the writer undertook a comparative study to investigate the mathematical attitudes and competencies of both prospective and experienced elementary teachers.

PURPOSE

The purpose of the study was (a) to determine if there

was a significant relationship between the mathematical attitudes and competencies of prospective and experienced elementary teachers and variables germane to both samples; (b) to determine if there was a significant difference between the mathematical achievement of prospective and experienced elementary teachers; and (c) to determine if there was a significant difference between the attitudes toward mathematics of both samples.

PROCEDURES

The study was based on a random sample of 1,008 prospective and experienced elementary teachers in the State of Texas during the 1972 Spring Semester. The participating colleges and universities making up the prospective teacher sample were randomly selected from the 49 institutions of higher learning with approved programs leading to an elementary teaching certificate (Walker 1971). Of the 13 institutions selected, seven were state and six were privately supported. The 13 institutions represented most of the geographical regions of the state. The final prospective teacher sample consisted of 724 junior and senior elementary education majors enrolled in student teaching at the six private (N=143) and seven state (N=581) institutions. (The sampling procedures for the study were extremely detailed; however, for the purpose of brevity, it should be noted that both large and small state and private institutions were included in the study).

The experienced elementary teacher sample of 284 was composed of regular full-time teachers from ten private and public elementary schools (K-6) in the Greater Houston Area during the 1972 Spring Semester. The community where each school was located may be described as primarily residential, commuter-suburban settlements with little or no industry and located within 25 miles from the central business area of Houston. Of the 284 experienced teachers, 57 had been awarded the Master's Degree, one the Doctorate, and seven had not been awarded a degree.

HYPOTHESES-STATISTICAL TREATMENT

The following null hypotheses tested were:

(1) There is no significant relationship between the mathematical competence and attitudes toward mathematics of prospective and experienced elementary teachers and certain selected variables.

(2) There is no significant difference between the mathematical achievement of prospective and experienced elementary teachers, as measured by the arithmetic subtests of a standardized achievement test.

(3) There is no significant difference between the attitudes toward mathematics of prospective and experienced elementary teachers, as measured by a widely used attitude scale.

(4) There is no significant difference between the mathematical achievement and attitudes of prospective elementary

teachers attending state institutions and those attending private institutions.

The statistical techniques used for analyzing the data were product-moment correlations and the t test for examining the difference in means between two independent samples (Ferguson 1966). All hypotheses were considered at the .05 level of significance.

DATA GATHERING INSTRUMENTS

For the purpose of collecting data from the prospective and experienced elementary teacher samples, two questionnaires, an attitude scale, and three arithmetic subtests of a standardized achievement test were administered to both samples.

The two questionnaires (a 15 item for prospective and a 19 item for experienced teachers), designed by the writer, contained items that were concerned with the respondents' sex, age, high school graduating class size, number of high school and college mathematics courses completed, number of mathematics methods courses completed, academic specialization, and grade level (K-3 or 4-6) teaching preference or assignment. One item on the prospective teacher questionnaire made reference to whether they attended a private or public institution. Additional information relating to the level of professional training, number of years teaching experience, number of mathematics classes taught each day, and the number of years since completing a mathematics content or methods course, was obtained from the experienced teachers.

The scale used for measuring the attitudes toward mathematics of both samples was the Revised Math Attitude Scale developed by L. R. Aiken and R. M. Dreger (Shaw and Wright 1967). The 20 item scale used the Likert scaling procedure with 10 of the items suggesting positive and 10 relating to negative attitudes toward mathematics. A test-retest reliability coefficient of .94 was reported by the authors.

The test used for measuring mathematical achievement of both samples was the Stanford Achievement Test, 1964 Advanced Battery, Form X. The three subtests relating to arithmetic computation, concepts, and applications were the only tests of the battery administered to the samples. (This test was recommended for use in grades seven, eight, and nine). Reliability coefficients reported for the three subtests ranged from a low of .76 in grade seven to a high of .92 in grade nine (Kelley 1964).

RESULTS

The results of the data were classified as (1) descriptive and (2) statistical. The descriptive data gave the characteristics of both samples (without statistical implications) that were obtained from both questionnaires. The statistical data sighted correlation summaries of the null hypotheses stated previously.

DESCRIPTIVE DATA

Approximately 95 per cent of both samples were female

with more than 90 per cent of the prospective and 71 per cent of the experienced teachers being under 35 years of age. The most common high school graduating class sizes for both samples were classes of 51-150 and classes larger than 450.

It is interesting to note that between 11 and 12 per cent of both samples had not completed a single college level mathematics course, while only 26 per cent had completed as many as three. Almost 19 per cent of the prospective and 23 per cent of the experienced teachers indicated they had not completed a single methods course in teaching elementary school mathematics. Attention should also be directed to the fact that at least 90 per cent of both samples failed to meet the minimum Committee on the Undergraduate Program in Mathematics (CUPM) recommendations for undergraduate elementary school teachers (Wagner 1963).

Language Arts and Social Studies were named as the most common academic specializations for both groups. Mathematics was selected by only 4.6 per cent of the prospective and 3.5 per cent of the experienced teachers.

The experienced teacher sample provided additional data which revealed that 59 per cent of the sample had five or fewer years teaching experience, while only 4.6 per cent had more than 20 years. Approximately 30 per cent of the sample did not teach mathematics as part of their regular teaching load. Over one-third of the sample reported that it had been between five and 10 years since they had completed a college

level mathematics content or methods course, while 16 per cent indicated that it had been more than 10 years.

STATISTICAL DATA

Product-moment correlations were obtained from the three arithmetic subtest scores and each variable previously discussed. For the purpose of this article, only the correlations between the total arithmetic scores and each variable are presented. It is the opinion of the writer that the total arithmetic scores correlated with each variable reflect an accurate account of the statistical data obtained from the study.

Results of the mean arithmetic subtest scores for both samples are presented in Table 1.

TABLE 1

PROSPECTIVE-EXPERIENCED ELEMENTARY TEACHERS' MEAN RAW SCORES ON EACH ARITHMETIC SUBTEST

Subtests	Number of items	PET* Items Correct	Per Cent Correct	EET* Items Correct	Per Cent Correct
Computation	41	30.19	73.6	30.11	73.4
Concepts	40	28.50	71.3	28.26	70.7
Applications	36	21.51	59.8	23.39	65.0
Total	117	80.20	68.5	81.76	69.9

*PET - Prospective Elementary Teachers

*EET - Experienced Elementary Teachers

The results of this study were rather more encouraging than those reported by Fulkerson (1960) in his study of 158 prospective and experienced elementary teachers in 1955. On a 40 item arithmetic test, prospective teachers attained a mean raw score of 17.9 while the experienced teachers had a mean raw score of 25.6 items correct. Results of this study, like Fulkerson's, revealed that experienced elementary teachers answered correctly a larger percentage of the items than did the prospective teachers.

Both samples in this study produced raw scores on the total achievement test (117 items) ranging from a low of 19 to a high of 116. The range of scores presented here was similar to other studies that investigated prospective and experienced elementary teacher competence in mathematics. Creswell (1967) reported a range in raw scores of four to 112 on a 120 item arithmetic test given to 1,075 elementary school teachers in 1965. Approximately 67 per cent of Creswell's sample achieved a raw score of 65 or less, with a mean score of 56.31 items correct. A group of 124 sixth-grade students taking the same test (120 items) achieved a mean score of 65.25 items correct.

Total achievement scores for prospective and experienced teachers in this study did not differ greatly from scores reported by Bean (1959). In his study, 450 experienced elementary teachers answered correctly 65 per cent of the items on an 80 item test, while the respondents in this study

answered 68.5 per cent of the 117 items correctly.

Achievement subtest and total scores were converted to grade scores and percentile ranks in order to compare prospective and experienced elementary teacher performance with a standardized population (Kelley 1964). When comparing the achievement of both samples to the sixth and seventh grade norms, their scores were sufficiently high enough to place them within the ninety to ninety-eight percentile range. However, when these same scores were compared to the eighth and ninth grade norms, they ranked in the seventy and sixty percentile ranges respectively. These comparisons might be an indication that prospective and experienced elementary teachers do not possess the desired mathematical fundamentals that are expected of most junior high school students.

COMPARING ACHIEVEMENT, ATTITUDES, AND SELECTED VARIABLES

Prospective and experienced elementary teachers' achievement and attitudes toward mathematics were significantly related to the number of high school and college mathematics courses completed and grade level teaching preference or teaching assignment. Respondents that completed a greater number of mathematics courses (high school and college) attained higher scores on arithmetic achievement and had more positive attitudes toward mathematics than those teachers completing fewer courses.

The findings of this study were opposed to those reported by Carroll (1961), who concluded that there was no

significant relationship between mathematics understanding and the amount of high school or college mathematics studied. Similarly, Phillips (1953) reported that mathematics achievement in meaning, understanding, and mechanical mastery did not reflect the extent of pre-college preparation in mathematics. Gilbert (1966) and Withnell (1967) on the other hand, reported that a stronger high school and college mathematics background resulted in a better understanding of arithmetic.

Prospective elementary teachers selecting grades 4-6 as a teaching assignment and those experienced elementary teachers assigned to those same grade levels, reported higher achievement scores and more positive attitudes toward mathematics than their counterparts with preferences or assignments in grades K-3. These results agree with those reported by Kane (1968). Kane reported a distinct difference between the attitudes of students preferring to teach in grades K-3 and those wanting to teach in grades 4-6. Prospective teachers in the 4-6 group attained more positive attitude scores than did those in the K-3 group.

As one might expect, those prospective and experienced elementary teachers selecting mathematics as an academic specialization reported higher achievement scores and more positive attitudes toward mathematics than their peers selecting specializations other than mathematics. Prospective and experienced elementary teachers selecting Art as their

academic specialization reported the lowest achievement in mathematics and had the least positive attitudes toward mathematics.

Significant relationships were found between achievement in mathematics and age for the experienced elementary teachers but not for the prospective teachers. This is not surprising due to the restricted age range of prospective teachers (74 per cent fell within the 18-24 age bracket). Younger experienced teachers (18-24 years of age) scored significantly higher in achievement than did experienced teachers in the other age brackets. The number of methods courses completed by experienced teachers, unlike prospective teachers, was significantly related to achievement in mathematics. Experienced teachers completed more methods courses than prospective teachers; however, a distinction was not made between undergraduate and graduate courses. This might also account for the significant difference between the correlations of both samples. In addition, the data also revealed that there was no significant relationship between sex and mathematical achievement for both groups.

Prospective and experienced elementary teachers that possessed a more positive attitude toward mathematics were male and those respondents teaching or planning to teach in grades 4-6. Attitudes toward mathematics of prospective and experienced elementary teachers were found not to be significantly related to age and the size of high school graduating class.

In addition, the level of professional training, teaching experience, and the number of years since completing a college level mathematics content or methods course was found not to be significantly related to the attitudes toward mathematics of experienced teachers. These results were similar to those reported by Stright (1960). She concluded that the teacher's educational background, recent training, teaching experience, and age, appeared not to be significantly related to his attitude toward the teaching of arithmetic.

Experienced elementary teachers' attitude toward mathematics was significantly related to the number of classes in mathematics they taught each day. Experienced teachers teaching mathematics in a departmentalized or semi-departmentalized program reported more positive attitudes toward mathematics than those teachers not teaching mathematics or those teaching mathematics in a self-contained classroom.

PROSPECTIVE VS. EXPERIENCED ELEMENTARY TEACHERS—
COMPARING ACHIEVEMENT AND ATTITUDES

In order to test for significant differences between the achievement in mathematics and between the attitudes toward mathematics of prospective and experienced elementary teachers, the t test was used to test the difference between the means of independent samples.

The data revealed in Table 2 indicate that there were no significant differences between the computation, concepts,

TABLE 2

DIFFERENCES BETWEEN THE MEANS OF ARITHMETIC ACHIEVEMENT FOR PROSPECTIVE AND EXPERIENCED ELEMENTARY TEACHERS

	Prospective Elementary Teachers N=724	Experienced Elementary Teachers N=284	Diff.	t
Computation	30.19	30.11	0.08	0.140
Concepts	28.50	28.26	0.24	0.500
Applications	21.51	23.39	1.88	4.700**
Total	80.20	81.76	1.56	1.181

** Significant at the .01 level

and total arithmetic achievement scores of prospective and experienced elementary teachers. Experienced teachers, however, did score significantly higher in arithmetic applications than prospective teachers.

Attitude scores presented in Tables 3 and 4 indicate the respondents' feelings toward mathematics, as measured by the Revised Math Attitude Scale. The scale measured a person's attitude toward mathematics in terms of a negative, neutral, or a positive attitude. The scoring procedure for the scale was altered (for this study) for the convenience of facilitating the electronic scoring device used to interpret the data. The original scale reflected a range from zero (negative) to 80 (positive) with a score of 40 representing a

neutral feeling about mathematics. The scores reported for this study were reversed, thereby causing a score of 20 to be highly positive and a score of 100 to be highly negative. A score of 60 denoted a neutral feeling toward mathematics.

TABLE 3

DIFFERENCES BETWEEN THE MEAN ATTITUDE SCORES OF PROSPECTIVE AND EXPERIENCED ELEMENTARY TEACHERS

	Number of Subjects	Mean Scores	Difference	t
Prospective Elementary Teachers	724	53.45		
Experienced Elementary Teachers	284	49.81	3.64	2.912**

** Significant at the .01 level

As indicated in Table 3, a significant difference existed between the attitudes toward mathematics of prospective and experienced elementary teachers. Experienced elementary teachers seemed to have a slightly more positive attitude toward mathematics than prospective elementary teachers.

Part of the data obtained from the prospective elementary teacher questionnaire was related to the instituion (public or private) they attended. An examination of Table 4 revealed that prospective elementary teachers attending privately supported colleges or universities scored

TABLE 4

DIFFERENCES BETWEEN THE MEAN ARITHMETIC ACHIEVEMENT AND ATTITUDE SCORES OF PROSPECTIVE ELEMENTARY TEACHERS ATTENDING STATE AND PRIVATE INSTITUTIONS

	Prospective Teachers			
	State Institutions N=581	Private Institutions N=143	Diff.	t
Computations	29.89	31.93	2.04	3.090**
Concepts	28.08	30.23	2.15	3.981**
Applications	21.30	22.40	1.10	2.444*
Total	79.16	84.51	5.35	3.566**
Attitude	54.25	49.47	4.78	3.083**

* Significant at the .05 level

** Significant at the .01 level

significantly higher on each of the arithmetic subtests than the prospective elementary teachers attending state supported colleges and universities. In addition, their attitudes toward mathematics were significantly more positive.

SUMMARY

The results of this study indicated that there was no significant difference between the arithmetic achievement of prospective and experienced elementary teachers. The only significant difference occurred when a comparison between the arithmetic application scores of prospective teachers

was made with those of the experienced teachers, with the difference being in favor of the latter. Experienced teachers also had a more positive attitude toward mathematics than the prospective teachers. In addition, prospective elementary teachers attending private institutions had significantly more positive attitudes toward mathematics and scored significantly higher in mathematical achievement, than those prospective elementary teachers attending state institutions. It should be pointed out, however, that while many of the product-moment correlations were statistically significant at the .05 and .01 levels, most of the coefficients were low in size and indicate only minor or weak trends.

While there are many variables that may affect prospective and experienced teachers' mathematical achievement and attitudes toward mathematics, there are several that have more predominant influence than others. The number of high school and college mathematics courses completed appear to be the most dominant factors in determining mathematical achievement and causing positive attitudes toward mathematics. The size of the high school graduating class and grade level teaching preference appear to be other influencing factors in determining attitudes toward mathematics and mathematical achievement.

IMPLICATIONS FOR TEACHER EDUCATION PROGRAMS

On the basis of the results of this study, there are a

number of variables that appear to play significant roles in determining prospective and experienced teachers' attitudes toward mathematics and their competence in mathematics. Since the number of high school and college mathematics courses completed appear to be the best indicator of mathematical achievement and seem to be the greatest influencing factor in shaping positive attitudes toward mathematics, teacher preparation institutions should give careful consideration to the pre-college and college level mathematics training of prospective elementary teachers. An investigation of the general information catalogues of many state and private colleges and universities reveals that a number of institutions responsible for training teachers, do not require a single course in mathematics designed specifically for the elementary teacher. It would appear that by implementing a minimum mathematics requirement for all elementary education majors, the level of mathematical competence of these teachers might improve significantly. In addition, it would not seem unreasonable for all colleges and universities to place a high priority on satisfying the CUPM Level I recommendations for elementary teachers.

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